Methods of underwater autonomous navigation

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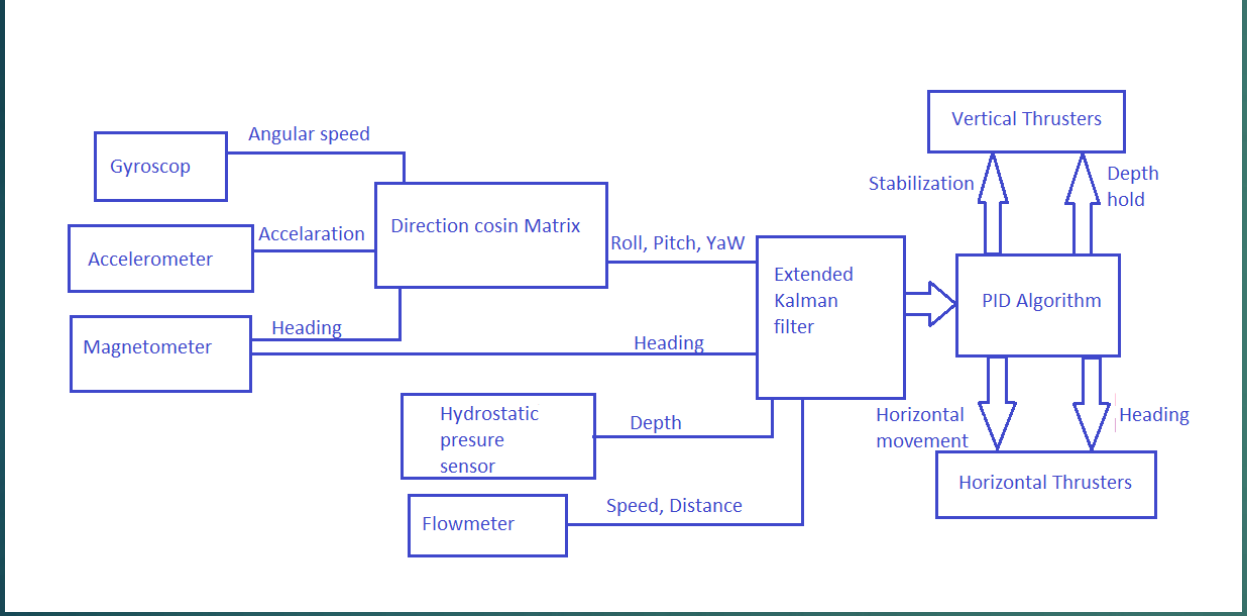
Abstract

- The use of robots in the maritime industry is becoming more widespread in its different branches. Underwater autonomous vehicles (UUVs) have become an essential tool for various underwater activities. Compared to other autonomous systems, navigation and localization for UUVs are particularly difficult due to the unavailability of the Global Positioning System (GPS), where signals are attenuated under water and the complexity and instability of the environment are big. Alternative methods such as acoustic positioning systems, inertial navigation systems (INS) and geophysical navigation approach are used for navigation. In this paper is presented three methods for underwater navigation and the algorithm used to follow a trajectory. The flowmeter is used in this application to identify the underwater route and the results are compared with the inertial sensors (IMU) test especially the magnetometer results. The two prediction are used using PID and Kalman filter to identify the trajectory.

ROV Classification

- ROVs are classified into categories based on size, weight, ability, power or destination [2,3].
- Depending on the destination, they can be classified as follows:
- - Military ROV
- - Scientific ROV
- - Educational.
- - Commercial ROV

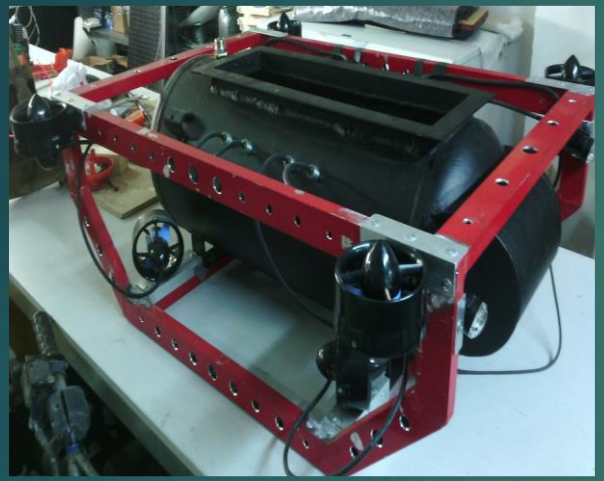
AUV System

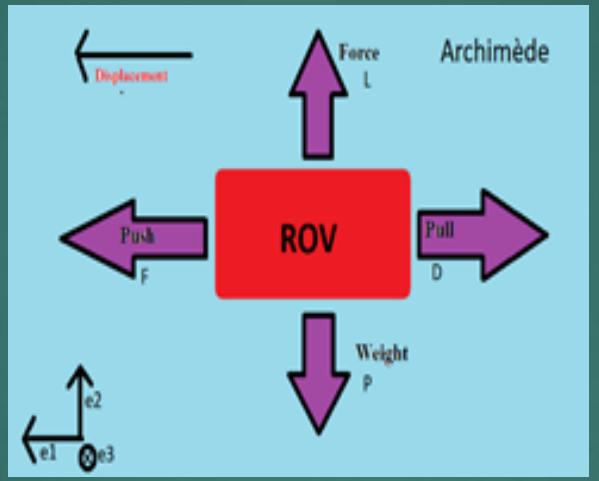


The signal bloc diagrame of AUV

The electronic part of the underwater AUV

ROV

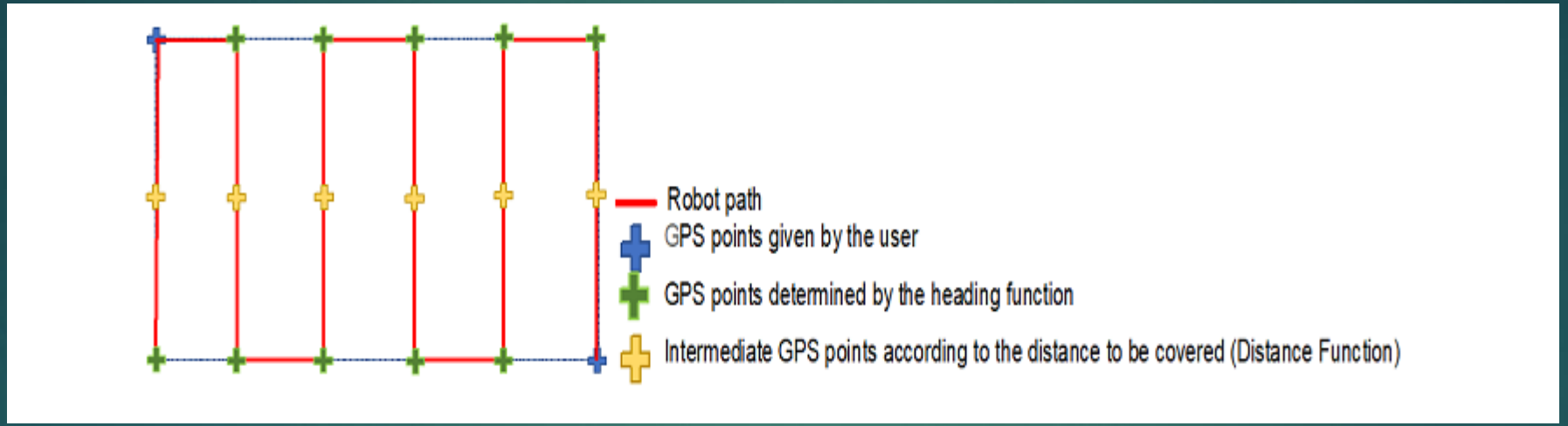




The underwater ROV body a) and the forces on the ROV body b)

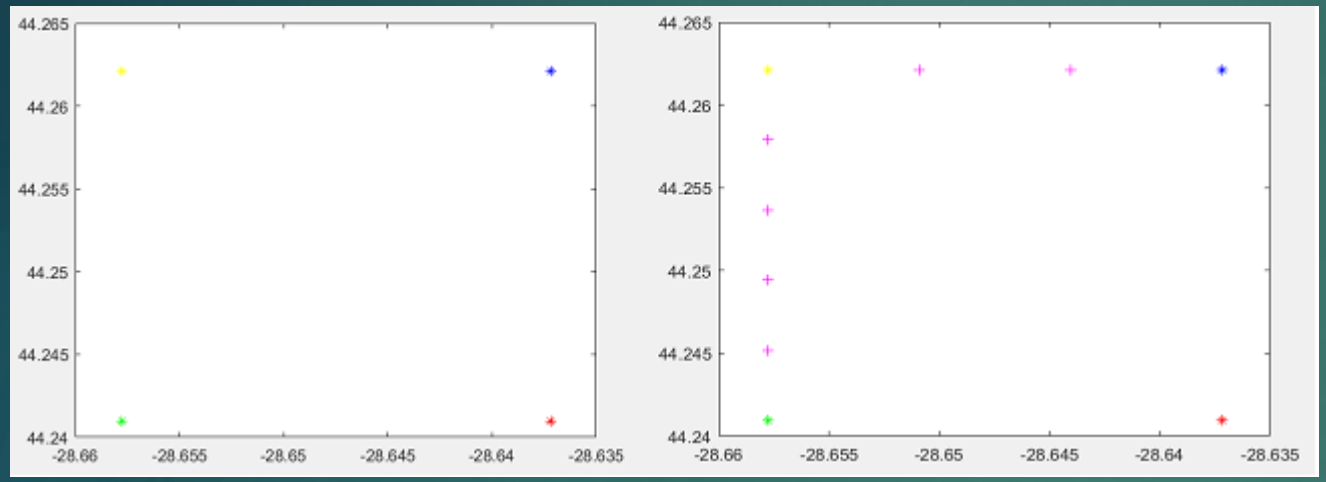
The project proposes a "blind" navigation solution using an inertial IMU (Inertial Measurement Unit) sensor to determine the relative position of the robot and its orientation to the magnetic north, the GPS mode to find the initial coordinates and establish the route trajectory , a water pressure sensor for determining the depth at which it is located and a flow meter for measuring travel speed.

TRAJECTORY IDENTIFICATION



The objective is to allow the robot to establish a series of GPS points along a trajectory using two points with different coordinates (representing the corners of a rectangle) and a verification precision given by the user.

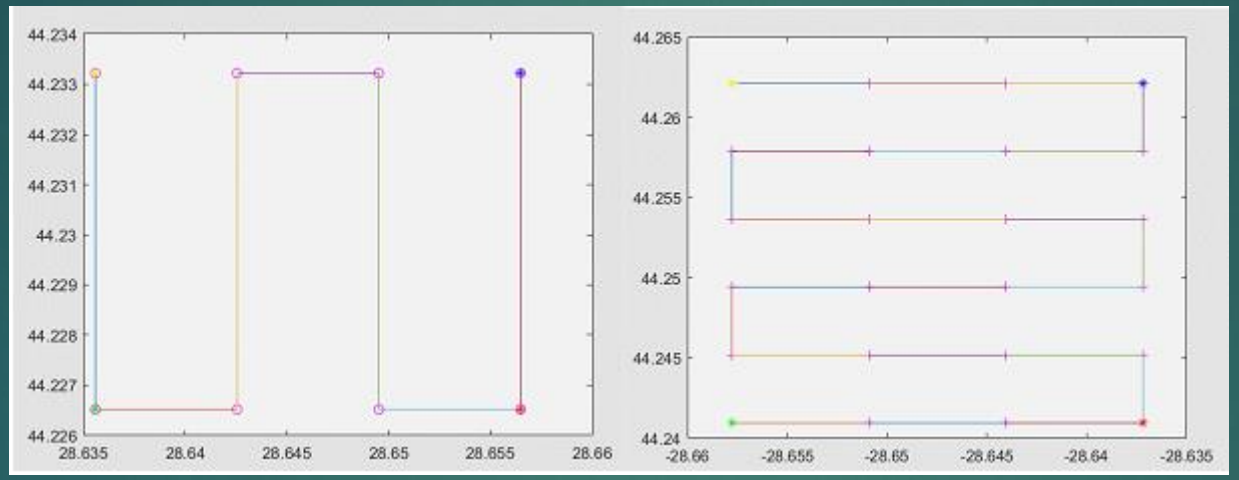
Trajectory identification




```
P3 = [P1(1),P2(2)];

P4 = [P2(1),P1(2)];

P1 = [44.262111,-28.657773];

P2 = [44.240945,-28.637183];
```

Representation of the area to be filmed a) Representation of verification points on the sides of the area b)

Trajectory identification



Representation of the trajectory for a distance between latitudes greater than that of longitudes a) Representation of the trajectory for a distance between longitudes greater than that of latitudes b)

CONCLUSION

- To allow a use the AUV on the whole of the southern hemisphere planet included we have adapted the software so that it works when the coordinates are negative. We encountered a last problem which we did not manage to solve, if the submarine were to be used around the equator or around the meridian of Greenwich, it does not manage to compose a correct path in the requested area. In conclusion, the function can be used in the vast majority of cases, but there are still gaps to be filled so that it works perfectly in all cases.

Acknowledgement

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- Thank you

- Slide no.P3.2.